Jet-Fan and CFD

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EFFECTIVE energy practice has been widely encouraged with the continuous depleting energy resources. Savings in any energy usage will result in the longer lifespan of fuel or energy reserve.

The conventional ducting design for ventilation is one of the main stumbling blocks to energy savings in the air conditioning industry. This is especially true for underground car park ventilation system.

Today, the application of jet-fan in underground car park has shown signs that it could help to overcome this problem. However, the jet-fan application is still very much at the infancy stage, and has yet to be widely accepted. Thus, the Computational Fluid Dynamics (CFD) tool has frequently been deployed during the design stage to validate the system, to ensure efficient and safer use of jet-fan application.

CFD is an established numerical approach to solve fluid flow problems with known boundary conditions. CFD is being used in fluid flow analysis, from giant air movement around the earth for weather forecasting, air conditioning, flow of water, down to the flow in tiny blood vessels.

A case study was recently conducted on jet-fans application in a basement car park. The CFD simulations check and ensure that the air ventilation is sufficient for normal operation as well as in case of fire, for safe evacuation and to provide clear headroom for fire fighters. Besides, it could also predict CO and CO_2 contamination.

Jet-fan application may potentially offer a solution for future basement car park and low head room floors. The following is an example of an underground car park flow visualisation (in top-view cut plane). The whole car park is installed with several jet-fans and the air flow simulated with CFD.

Figure 1 shows the jet-fan in front of a cross beam without lowering the jet-fan position. The jet-fans in front of beams are installed with flow deflectors at a certain angle, and the light blue indicates a higher velocity compared to the dark blue which is dead flow zones. Figures 2(a) and (b) shows the velocity contour plots for the car park with and without jet-fan, operating under normal conditions.

In summary, the application of CFD has become more and more popular and it could help to provide a reliable solution to jet-fan system design evaluation. ■

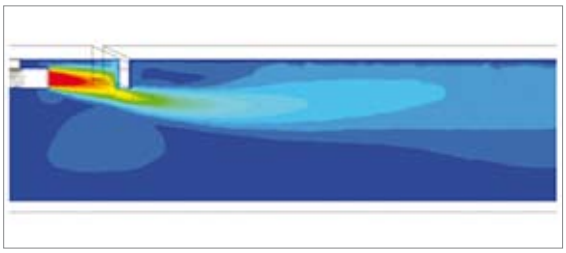

Figure 1: Velocity contour plot - side view with cross beam for normal operation 12m/s zoomed-in for cross beam 4m apart (red is 12 m/s, blue is low velocity)

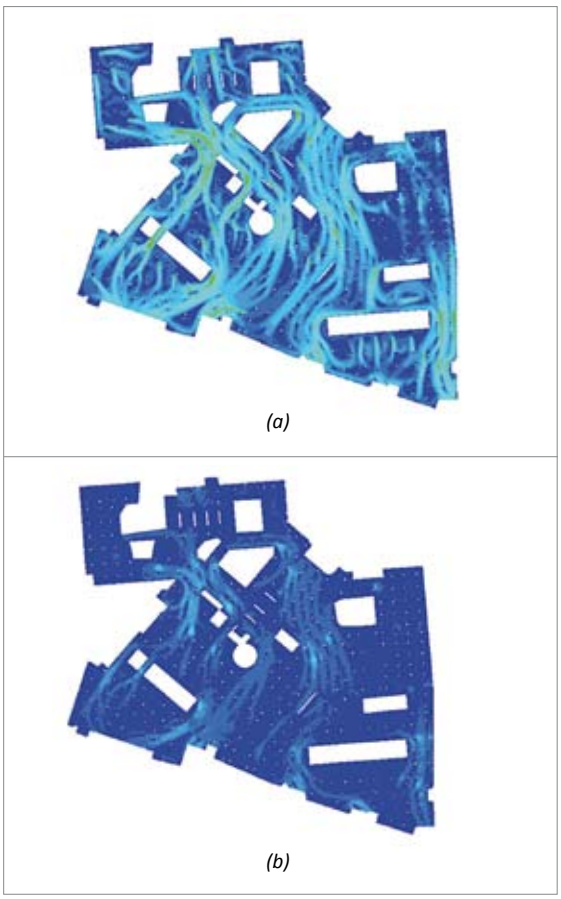

Figure 2: Top view of car park basement (a) with jet-fans, and (b) without any jet-fan. The darker the blue colour, the slower the air velocity